THE INFLUENCE OF COMMERCIAL FERTILIZERS, POTASSIUM IODIDE, AND SOIL ACIDITY ON THE IODINE CONTENT OF CERTAIN VEGETABLES [1]

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INTRODUCTION

Studies were begun at the Pennsylvania State College in 1931 to ascertain the influence of long-continued fertilizer treatments of field plots on the iodine content of vegetables grown on them, and to determine the extent to which the iodine content of certain vegetables was increased by an application of potassium iodide to field plots on which the acidity had been modified with sulphur or calcium hydroxide.

WORK OF OTHER INVESTIGATORS

Various aspects of iodine fertilization have been studied by other investigators, both with respect to the growth of plants and the yield of crops, and to the iodine content of the plants to which the iodine compounds were applied. A few studies also have been made to determine the influence of the iodine contained in certain fertilizers on the iodine content of vegetables; these studies, however, have dealt with applications of iodine-containing commercial fertilizers to the current crop, and not with long-continued use of these fertilizers on the same plots.

A number of investigators have reported that iodine compounds, either in nutrient solutions, pot cultures, or field plots, have improved the growth and yields of plants, under the conditions stated. Doerell (*8*)[3] found that 3.2 or 4.2 kg of iodine per hectare increased the yield of hops. He suggested that the iodine in commercial sodium nitrate or superphosphate, amounting to about 100 g per hectare, was beneficial to crops. Loew (*22*) reported increases in yield of both tops and roots of radishes fertilized with 0.5 and 0.05 g of potassium iodide to the plot of 20 m^2 as compared with unfertilized checks, the smaller application producing the largest yield. Malhotra (*26*) stated that moderate fertilization of soil with iodine—5.0 mg per kg of soil naturally containing 0.85 mg per kg—stimulated the growth of carrots somewhat. Mazé (*28*) found that to obtain full growth of maize in nutrient solutions of N, P, K, Ca, Mg, S, Fe, Mn, Zn, Si, and Ce from commercial chemical compounds in distilled water, it was necessary to add iodine, boron, aluminum, and fluorine. Scharrer and Schropp (*32*) observed a slight stimulation of growth of wheat growing in gravelly soil with nutrient solutions, when low concentrations of iodine compounds were used. Stoklasa (*35*, *37*)

[1] Received for publication Feb. 7, 1936; issued January 1937. Paper no. 717 of the Journal Series of the Pennsylvania Agricultural Experiment Station.

[2] The writers are indebted to D. E. H. Frear, of the Department of Agricultural and Biological Chemistry of the Pennsylvania State College, for many suggestions in carrying out the analytical part of the work and in preparing this report, and to the Department of Agricultural and Biological Chemistry for the loan of apparatus and reagents.

[3] Reference is made by number (italic) to Literature Cited, p. 798.

improved the growth of sugar beets with 0.02 g of iodine as potassium iodide in 12 kg of soil per pot culture. Weiske (*40*) found that barley and spinach were stimulated by iodine compounds applied at about 5 to 10 times the rate contained in Chile saltpeter applications. Suzuki (*38*), and Suzuki and Aso (*39*) found that peas, oats, and radishes were stimulated by KI treatment.

Other investigators, however, have reported crop reduction or injury to plants as a result of iodine treatment. Beaumont and Karns (*2*) found a slight decrease in yield of turnips resulting from the application of KI at the rate of 2 kg per hectare. Cotton (*5*) observed injury to buckwheat from iodine as KI in nutrient solutions, in concentrations from 0.13 to 126.9 parts per million. Dafert and Brichta (*6*) found no differences in the growth of barley, mustard, and turnips resulting from the use of iodine in amounts equal to those present in the usual field applications of Chilean nitrate of soda. Doerell (*8*) noted a reduction in yield of hops from applications of 5.4 kg of KI per acre, though the difference was probably not significant.

Engels (*9*) reported no stimulative effect of either KI or $NaIO_3$ on sugar beets and mangels in field plots. Fellenberg (*13*) noted no effect on yield of mangels from 2.0 kg of KI per hectare. Hiltner and Bergold (*21*) reported similar results with 400 to 600 g of KI per acre, with sugar beets. Malhotra (*26*) found that the application of 32.0 mg of KI per kg of soil soon killed carrots growing on it. Scharrer and Schropp (31) observed injury to oats, wheat, rye, and barley, in decreasing order of damage, from the use of iodine salts and noted less unfavorable effects on clay soil than on muck soil. They reported the following order of damage for the different iodine salts: iodide $>$ iodate $>$ periodate. Weiske (*40*) showed that the amounts of iodine compounds present in commercial Chile saltpeter did not influence crops, though 5 to 10 times these amounts were usually injurious, except to barley and spinach. Wrangell (*41*) could find no differences in yield of potatoes, beets, oats, spinach, lettuce, pumpkins, red clover, sprouts, beans, or alfalfa with either 1.5 or 6.0 kg of iodine per hectare in KI or soot, in pot cultures or field plots. Wynd (*42*) found that iodine concentrations from 1 to 20 parts per million from KI, in Shive's nutrient solution, in all cases reduced the growth of tomato plants, and in concentrations above 5 parts per million caused injury to the leaves.

Many of the investigators named above and others have reported increases in the iodine content of plants to which iodine applications had been made. Beaumont and Karns (*2*), Conner (*4*), Densch, Steinfatt, and Günther (*7*), Fellenberg (*10, 13, 14*), Hercus and others (*17, 19*), Hiltner (*20*), Hiltner and Bergold (*21*), Malhotra (*26*), Maurer, Schropp, and Ducrue (*27*), Orr, Kelly, and Stuart (*29*), Pfeiffer and Courth (*30*), Scharrer and Schwaibold (*33*), Scharrer and Strobel (*34*), and Stoklasa (*36, 37*) all reported increases, in some instances tenfold, in the iodine content of plants receiving iodine applications as compared with that of control plants. The largest amount of iodine found in any plant tissues as the result of fertilization with iodine compounds was 1,419,000 and 1,184,000 parts per billion of dry weight of radish leaves and roots, respectively, reported by Pfeiffer and Courth (*30*). Only Wrangell (*41*) found no increase in iodine content of plants as a result of iodine fertilization.

The iodine contained in commercial fertilizers has been reported by several investigators as increasing the iodine content of the crop, while others have observed no such effect. Conner (*4*) stated that fish meal as a source of nitrogen increased the iodine content of vegetables. Hercus and others (*18*, *19*) found that commercial fertilizers increased the iodine content of grasses, but ascribed this effect to improved growth rather than to the iodine content of the fertilizers. Analyses by Fellenberg (*10*, *11*), McHargue, Roy, and Pelphrey (*23*), Hercus, Benson, and Carter (*18*), and Hercus and Roberts (*19*) showed that commercial fertilizers of mineral origin contain considerable quantities of iodine. With the exceptions noted above, however, the investigators did not carry out experiments to ascertain whether the iodine contained in the fertilizers actually increased the amount of iodine present in the crop as harvested.

The effect of acidity of the culture medium upon iodine absorption by plants was investigated to some extent by Fellenberg (*15*) and by Malhotra (*26*). The former studied iodine absorption on two very acid soils (pH 4.4 and 4.5) and on two moderately alkaline soils (pH 7.2 and 7.3). He found that carrots obtained more iodine, which was added as potassium iodine, from acid soils in pot cultures than from alkaline soils under similar conditions. He found, further, that acid soils liberated more iodine by catalytic action than did alkaline soils, and that the organic matter of the soil was active in fixing iodine in soils. Malhotra (*26*) found that iodine absorption by carrots in nutrient cultures was lowest at pH 9.0, next lowest at pH 4.0, and highest at pH 6.0; at pH 5.0, 7.0, and 8.0, absorption was intermediate. Densch, Steinfatt, and Günther (*7*) found that liming increased the iodine content considerably when no iodine was added to the soil, but had little effect with the maximum amount of added iodine.

METHODS

The analytical procedure in most of these studies was similar to that described by Frear (*16*), except for certain modifications in the combustion apparatus. According to this procedure, dried, ground samples of plant material are burned with commercial oxygen in a closed apparatus provided with chambers for precipitating smoke and for scrubbing volatile products of combustion; the ashes, precipitated smoke, and scrubbing solutions are collected, evaporated to dryness in excess of alkali, and the iodine compounds in them are extracted with alcohol. After the alcohol has been removed by evaporation, the iodine compounds are dissolved in water, oxidized, and estimated titrimetrically.

The final form of the combustion flask used in these studies was a wide-mouthed (53 mm) 1-liter pyrex Erlenmeyer flask, fitted with a rubber stopper through which were inserted an oxygen inlet tube of 5-mm bore, an outlet tube of 7-mm bore for gaseous products of combustion, and a thick-walled tube of 27-mm bore through which the sample was introduced for combustion, all of pyrex glass. The large tube was about 30 cm in length, and was inserted through the stopper so as to extend well into the body of the flask. The sample of dried, ground vegetable material was introduced through this tube in the way described by Frear. The oxygen inlet tube extended to the end of the large tube inside the flask, and was bent toward the large tube at that point, so as to deliver oxygen directly to the point at which combustion took place (fig. 1).

The flask was supported by means of clamps in a horizontal position, so that ashes fell from the end of the sample as it was burned; the ashes were not subjected for any considerable length of time to the heat of the flame, as they were when the sample was burned in the vertical position employed by Frear.

The absorption apparatus included, in order, a water-jacketed condenser, a trap vessel for condensed liquids, and three Cottrell precipitators alternated with absorption towers containing glass beads moistened with saturated potassium carbonate solution.

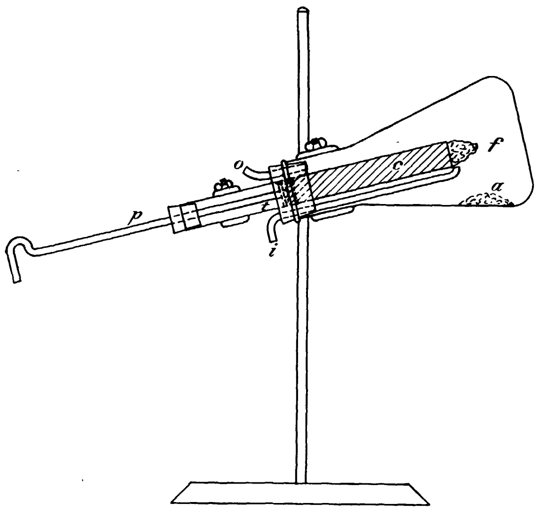

FIGURE 1.—Combustion apparatus for iodine analysis: *p*, Plunger for moving the cartridge of dried, ground sample, *c*, through the tube, *t*; *i*, oxygen inlet; and *o*, outlet for gaseous combustion products; combustion is carried on inside the flask, *f*; and ash, *a*, accumulates as it falls from the burning tip of the cartridge.

Samples were prepared for analysis by slicing, drying at 70° C., grinding in a Wiley mill, and storing in glass-stoppered bottles. Before being ignited they were mixed with about 5 percent of their weight of powdered $CaCO_3$, which was found to improve the smoothness of burning of the sample. In other respects, the analytical procedure was similar to that followed by Frear (*16*), to whose paper the reader is referred for details of the method.

The accuracy of the analytical method was determined by analysis of three different lots of vegetable material before and after the addition of known quantities of potassium iodide. Two lots of tomatoes and one of asparagus were used. Recoveries were made of from 95 to 99 percent of the quantities added. In asparagus, which was found to contain 108 micrograms of iodine, and to which 85 micrograms were added, the total amount recovered was 189 micrograms. With one lot of tomatoes, 378 micrograms of iodine were found after 360 micrograms had been added to the 20 micrograms originally determined in the sample itself; in the second lot, 358 micrograms were found after 360 micrograms has been added to a sample estimated to contain 15 micrograms of iodine.

Analyses were duplicated; if the results of the duplicates were not very closely in agreement, three or more analysis were made.

Tomatoes (*Lycopersicum esculentum* Mill.) sweet corn (*Zea saccharata* Sturt.), and potatoes (*Solanum tuberosum* L.) grown on certain of the plots in a fertilizer experiment with truck crops were analyzed, in an effort to find the relation between iodine content and the amount and kind of fertilizer used. The soil acidity of each plot was measured to ascertain the relation, if any, between iodine content and soil acidity.

The fertilizers, which varied in the proportions of nitrate of soda, superphosphate, and muriate of potash, were similar in analysis to those that had been applied annually with a few exceptions, since 1917, to the plots from which the samples were taken. (A full description of the fertilizer experiment of which these plots are a part is contained in Pennsylvania Bulletin 210 (*25*). The fertilizers were applied broadcast and were harrowed in before the crops were planted. The particular lots used in the season in which samples were taken (1931) were Chilean nitrate of soda, 16 percent superphosphate, and muriate of potash. The amounts of these materials which were applied to the various plots are given in table 1.

Soil acidity in terms of pH was measured electrometrically, a potentiometer with a quinhydrone electrode being used.

TABLE 1.—*Iodine content of truck crops as influenced by fertilizer treatment and soil acidity*

POTATOES

Fertilizer treatment (pounds per acre)	Plot no.	pH of soil	Yield per acre	Iodine content on basis of— Fresh weight	Iodine content on basis of— Dry weight
			Tons	*Parts per billion*	*Parts per billion*
625 superphosphate, 167 muriate of potash	1–8	6.60	4.4	46	180
	4–10	6.94	3.9	48	210
Average			4.2	47	195
600 nitrate of soda, 625 superphosphate, 167 muriate of potash	5–14	6.30	2.8	55	220
400 nitrate of soda, 167 muriate of potash	1–7	6.51	2.7	60	240
	4–11	6.42	3.9	50	200
Average			3.3	55	220
400 nitrate of soda, 938 superphosphate, 167 muriate of potash	5–10	6.80	5.7	41	190
400 nitrate of soda, 625 superphosphate	1–6	6.55	4.3	51	200
	4–12	6.66	2.9	40	150
Average			3.6	45.5	175
400 nitrate of soda, 625 superphosphate, 250 muriate of potash	2–12	6.55	4.5	93	410
	5–6	6.88	4.6	50	210
Average			4.6	71.5	310
Average				53.4	221

TOMATOES

Fertilizer treatment (pounds per acre)	Plot no.	pH of soil	Yield per acre	Fresh weight	Dry weight
625 superphosphate, 167 muriate of potash	1–8	6.60	13.4	16	230
	4–10	6.73	10.2	8	240
Average			11.8	12	235
600 nitrate of soda, 625 superphosphate, 167 muriate of potash	5–14	6.30	14.7	8	170
400 nitrate of soda, 167 muriate of potash	1–7	7.30	11.1	19	250
	4–11	6.77	8.1	12	220
Average			9.6	15.5	235
400 nitrate of soda, 938 superphosphate, 167 muriate of potash	5–10	6.59	13.2	7	150

TABLE 1.—*Iodine content of truck crops as influence by fertilizerd treatment and soil acidity*—Continued

TOMATOES—Continued

Fertilizer treatment (pounds per acre)	Plot no.	pH of soil	Yield per acre	Iodine content on basis of—	
				Fresh weight	Dry weight
			Tons	*Parts per billion*	*Parts per billion*
400 nitrate of soda, 625 superphosphate	1-6 4-12	7.52 6.87	17.1 13.8	14 17	300 370
Average			15.5	15.5	335
400 nitrate of soda, 625 superphosphate, 250 muriate of potash	2-12 5-6	6.28 6.38	17.5 15.8	8 13	160 320
Average			16.7	10.5	240
Average				12.2	241

SWEET CORN

Fertilizer treatment (pounds per acre)	Plot no.	pH of soil	Yield per acre	Fresh weight	Dry weight
625 superphosphate, 167 muriate of potash	1-8 4-10	6.57 5.96	2.7 3.9	24 25	90 100
Average			3.3	24.5	95
600 nitrate of soda, 625 superphosphate, 167 muriate of potash	5-14	6.67	3.8	73	250
400 nitrate of soda, 167 muriate of potash	1-7 4-11	6.59 6.09	2.4 2.4	37 24	140 120
Average			2.4	30.5	130
400 nitrate of soda, 938 superphosphate, 167 muriate of potash	5-10	6.74	4.8	50	190
400 nitrate of soda, 625 superphosphate	1-6 4-12	5.85 6.68	3.1 3.8	33 23	120 90
Average			3.5	28	105
400 nitrate of soda, 625 superphosphate, 250 muriate of potash	2-12 5-6	6.73 6.43	3.2 4.7	30 33	100 120
Average			4.0	31.5	110
Average				35.2	132

The plots are listed in table 1 in such a way as to show the effect of the presence or absence of each of the critical plant-food elements, nitrogen, phosphorus, and potassium. The first two plots in the table, plots 1–8 and 4–10, received phosphorus and potassium but no nitrogen; the third plot, 5–14, received the same amounts of phosphorus and potassium as the first two plots, together with a fairly heavy application of nitrogen. The fourth and fifth plots, 1–7 and 4–11, received nitrogen and potassium, but no phosphorus; the sixth plot, 5–10, received the same amounts of nitrogen and potassium as plots 1–7 and 4–11, together with a relatively heavy application of phosphorus. Similarly, plots 1–6 and 4–12 received nitrogen and phosphorus, without potassium, and plots 2–12 and 5–6 received the same amounts of nitrogen and phosphorus, together with a heavy application of potassium. The pH of most of the plots varied but little; the maximum variation for any crop was between 6.28 and 7.52, for tomatoes.

INFLUENCE OF FERTILIZER TREATMENT AND SOIL ACIDITY ON THE IODINE CONTENT OF POTATOES, TOMATOES, AND SWEET CORN

The variation in iodine content of potatoes from the different plots (table 1) was not great, with the exception of those from plot 2–12, which received a generous application of potassium. Potatoes from the second plot receiving the same fertilizer treatment (plot 5–6) did not differ widely in iodine content from those from the other plots. Obviously, there is no relation between either the fertilizer treatment, the acidity of the soil, or the size of the crop, and the iodine content of potatoes grown on the experimental plots. The same is true for tomatoes, although the iodine content of this crop was somewhat more variable among the different plots than was the case with potatoes. The iodine content of sweet corn apparently was increased by nitrate of soda on plot 5–14, as compared with plots 1–8 and 4–10; all other plots, each of which received two-thirds as much nitrate of soda as did plot 5–14, differed but little with respect to the iodine content of the sweet corn grown on them, from the plots without nitrogenous fertilizers.

The average iodine content of sweet corn from all plots, 132 parts per billion of the dry samples, was considerably below that of the tomatoes, 241 parts per billion, and that of the potatoes, 221 parts per billion. The difference between the tomatoes and potatoes in this respect is not significant.

INFLUENCE OF IODINE FERTILIZATION ON THE IODINE CONTENT AND YIELD OF BEANS AND TURNIPS

Studies were carried out in 1931 with beans (*Phaseolus vulgaris* L.) and turnips (*Brassica rapa* L.) to ascertain whether any considerable increase in iodine content might be effected economically by applications of an iodine compound to field plots. Soil acidity was introduced as an experimental variable, by modifying the acidity through additions of hydrated lime or sulphur.

Five plots, each 20 by 24 feet, were marked out on July 20, and materials were applied as follows:

Plot 1—44.0 pounds of hydrated lime (2 tons per acre).
Plot 2—22.0 pounds of hydrated lime (1 ton per acre).
Plot 3—Check.
Plot 4—66.0 pounds of sulphur (3 tons per acre).
Plot 5—110.0 pounds of sulphur (5 tons per acre).

These materials were broadcast and harrowed into the soil. Five rows each of Sure Crop Stringless Wax beans and Purple Top White Globe turnips were seeded on the same day, the beans in rows 30 inches apart, and the turnips in rows 18 inches apart, parallel to the longer side of the plots.

The hydrogen-ion concentration was measured electrometrically from time to time, to ascertain the progress of the change of acidity brought about by the materials applied. The results of these measurements are shown in table 2. The effects of the hydrated lime were immediate, while those of sulphur were not apparent before the second measurement, more than 2 weeks after the sulphur was applied.

TABLE 2.—*pH of plots on four dates during the iodine fertilization experiment*

Plot no.	pH of plots			
	July 27	Aug. 6	Aug. 18	Sept. 22
1	8.33	8.22	8.34	8.23
2	8.25	7.65	8.33	8.16
3	7.73	7.56	7.61	7.60
4	7.74	6.80	6.12	5.85
5	7.73	6.50	5.92	4.95

On August 21 the corresponding half of each plot, including half of each row of turnips and of beans, was fertilized with 12.984 g of potassium iodide, or at the rate of 2.356 kg to the acre. This was distributed by dissolving it in water and sprinkling it evenly upon the surface of the soil, between the rows of beans and turnips, the former of which were beginning to blossom by this time. After the solution had been distributed, the plants were sprinkled thoroughly with water, so that none of the solution would remain on the portions of the plants above ground. The iodine added to the upper 6 inches of soil in this application amounted to approximately 2.0 mg, or 2,000 micrograms, per kilogram, which is about one-half of the total iodine content of certain agricultural soils, as reported by Chatin (*3*), Fellenberg (*12*), Andrew (*1*), and McHargue, Young, and Roy (*24*). Each square foot of soil surface received 0.0413 g of iodine. The application was delayed until this time in order that marked differences in soil acidity might be brought about before the iodine was applied.

The effects of soil acidity and of iodine became evident within 2 weeks after the potassium iodide was applied. Both the beans and the turnips were noticeably more vigorous on the more alkaline lots, and were much less vigorous on the more acid plots. The turnips were especially low in vigor on the plots to which sulphur had been added. Probably this was due, in part, to the unfavorable soil acidity, but to a considerable extent it was attributable to aphid infestation. These infestations were severe only on the plots that had received sulphur applications. The effects of the potassium iodide on the two crops were opposite in character: the turnips were noticeably improved in growth, while the beans were injured, as was shown by the dropping of the lower leaves and the yellowing of the remaining ones, and a general stunting of growth.

The crops were harvested when they reached commercial maturity and their fresh weights recorded. The weights of the green bean pods also were recorded, and the entire harvest from each plot was prepared for iodine analysis. The turnips were weighed and 5-kg samples, made up of entire plants, were taken for analysis. In harvesting and sampling for analysis, a 2-foot strip between the plots, and between the iodine fertilized and unfertilized halves, was excluded. The harvested portions of the half plots, therefore, were 10 by 20 feet, of which 10 by 12.5 feet were occupied by beans, and 10 by 7.5 feet by turnips.

The yields and the iodine content in parts per billion of dry and of fresh weight of the crops from each plot are recorded in table 3. In this table, the halves of the plots to which potassium iodide was applied are designated by the letter A, while the unfertilized halves are designated by the letter B.

TABLE 3.—*Effect of soil acidity and potassium iodide fertilization with KI on the yield and iodine content of beans and turnips*

Plot no.[1]	pH of soil		Beans			Turnips		
	When KI was applied	When crop was harvested	Yield per plot	Iodine content on basis of—		Yield per plot	Iodine content on basis of—	
				Fresh weight	Dry weight		Fresh weight	Dry weight
			Kilograms	*Parts per billion*	*Parts per billion*	*Kilograms*	*Parts per billion*	*Parts per billion*
1A	8.34	8.23	6.75	73	730	37.55	9,496	94,960
1B	8.34	8.23	8.20	26	280	32.12	79	740
2A	8.33	8.16	3.85	84	1,170	27.13	5,692	51,740
2B	8.33	8.16	6.23	57	510	25.99	85	850
3A	7.61	7.60	2.33	71	750	22.50	2,044	19,540
3B	7.61	7.60	4.68	26	260	21.64	180	1,590
4A	6.12	5.85	2.43	56	570	9.89	2,607	24,140
4B	6.12	5.85	3.58	45	490	7.71	209	2,080
5A	5.92	4.95	1.21	122	1,410	7.63	2,148	21,140
5B	5.92	4.95	4.24	54	630	7.03	191	1,910

[1] The halves of plots to which KI was added are designated by the letter A, the unfertilized halves by B.

Table 3 shows that the yield of beans was reduced in every case by the addition of potassium iodide to the soil; the yield of turnips, on the other hand, was increased by iodine fertilization in every case. In general, the yields of both beans and turnips decreased rapidly as the acidity increased.

In turnips, which were stimulated in growth by fertilization with potassium iodide, the iodine content was enormously increased by this means. The increase ranged from a little more than tenfold on plots 3, 4, and 5, to about 120-fold on plot 1, on the basis of fresh weights. On the other hand, the iodine content of the beans, which were injured by potassium iodide, was increased to less than three-fold in all cases. The maximum increases in iodine content of turnips occurred on the most alkaline plots; the increases in iodine content of the beans evidently were not related to the acidity of the soil. On plots treated with potassium iodide, the iodine content of turnips was greater the higher the pH of the soil, except on plot 3; on plots without potassium iodide applications, on the other hand, the iodine content was greater the lower the pH, except on plot 5.

Turnips obtained far greater quantities of iodine from the soil to which no iodine was added than did beans. The fact that the entire plants of turnips were analyzed, however, while only the green pods were used for the measurements of iodine content of beans, should be considered.

On the basis of the yield and iodine content of turnips on plot 1A, the recovery of the added iodine by the turnips on this plot was 0.3536 g, or 11.4 percent of the amount added.

In view of the small recovery of added iodine, the plots were planted in 1932 in the same way as in 1931, but without applying any additional sulphur, hydrated lime, or potassium iodide, in order to ascertain whether any residual effect of the iodine applied in 1931 could be detected. No consistent effect could be observed in the growth and yield of either beans or turnips, both of which produced considerably smaller yields than in 1931. A number of these samples have been analyzed, and no residual effects of the potassium iodide applied in the previous season have been found.

SUMMARY

No relation was observed between the iodine content of potatoes, tomatoes, and sweet corn grown on field plots in a long-continued fertilizer experiment, and either the fertilizer treatment, the soil acidity, or the yield of the crop. The fertilizers used in the experiment were Chilean nitrate of soda, superphosphate, and muriate of potash.

An application of potassium iodide at the rate of 2.356 kg to the acre, supplying approximately 2.0 mg of iodine to the kilogram of soil in the upper 6 inches, increased the iodine content of green beans considerably as compared with that of beans similarly grown but without iodine fertilization, but it injured the plants and reduced the yields markedly. Similar applications of potassium iodide increased the yields of turnips somewhat, and increased the iodine content of the turnip plants from tenfold to 120-fold, on different plots. The greatest increases in iodine content of turnips occurred on plots made alkaline with hydrated lime, and the smallest increases on plots made acid with sulphur or unmodified in acidity.

The iodine content of turnips from plots not fertilized with potassium iodide was generally greater the more acid the soil; the iodine content of beans not treated with potassium iodide, however, was not influenced consistently by soil acidity.

The maximum recovery of added iodine by any turnip plants in the experiments was 11.4 percent. Analyses of plants grown on the same plots in the second season, without additional iodine, indicated that there was no residual effect of the iodine application.

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U. S. GOVERNMENT PRINTING OFFICE 1937